Science Policy in a Global World

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What kind of science policy, if any, can be implemented by developing countries in Latin America, given the current context of globalization and constraints in the resources at the disposal of national governments? This question was addressed by a science policy study carried on in Brazil in 1992-93, which is the basis of this presentation[1].

Latin America, of course, is a very heterogeneous region, and Brazil, because of its sheer size, may have options which are not open to smaller and less industrialized nations. In fact, the Brazilian policies for science and technology implemented in the sixties and seventies were part of a very ambitious project of national development and technological self-sufficiency which was not emulated by other countries in the region, at least not in the same scale, except by Argentina in a few areas (such as nuclear energy and military weaponry). However, some of the general assumptions current among Brazilian scientists and science policy makers were widely shared in the region, and in that sense this discussion about Brazil may be relevant to other countries as well.

The main conclusion of the science policy study of 1992-3 was that the thrust of the policies of the sixties and seventies had disappeared in the eighties, but had not been replaced by a new vision about the direction science and technology policies should take. Brazil remained a minor partner in the

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[1] S. Schwartzman, ed., *Science and Technology in Brazil, vol. 1: A New Policy for a Global World*, Rio de Janeiro, Fundação Getúlio Vargas, 1995; *Ciência e Tecnologia no Brasil, vol. 2: Política Industrial, Mercado de Trabalho e Instituições de Apoio*. Rio de Janeiro, Fundação Getúlio Vargas, 1995; *Ciência e Tecnologia no Brasil, vol. 3: A Capacitação Brasileira para a Pesquisa Científica e Tecnológica*. Rio de Janeiro, Fundação Getúlio Vargas, 1996.

world's science and technology effort, and in that sense more similar to other countries in the region than it seemed to be the case in the past.

My presentation can be divided in three parts. The first presents the main assumptions of the science policies of the sixties and seventies, and some of its achievements in Brazil. The second part is a summary of the new realities of the nineties, and their impact on the previous assumptions and achievements. The third is a discussion of the current science policy options.

The policies of the sixties and seventies were based on two assumptions which were not necessarily compatible with each other, but were widely shared by the international scientific community and strongly supported and preached by international and multilateral organizations. Fist, science had to develop freely, good projects and ideas should be supported in all cases, and scientists should be the ones to say what projects and should be supported and implemented. With more knowledge, education would improve, and also the economy. It was the "endless frontier" idea, although in a completely different context, and with far less human and financial resources to support it. Universities, and in some cases independent research institutes, should be the place for this activity. Second, and in apparent contradiction, science should be planned, and geared to specific economic and strategic needs. Developing countries should strive to obtain technologies which were denied to them by large, international interests, and link research and development to strategic projects and goals. This alliance between academic, "free" science and applied, mostly military technology was of course one of the main landmarks of science development in the US and Western Europe during the cold war. The contradiction between these two ways of doing science and technology could be solved, J. D. Bernal style, by placing the scientists themselves at the top of the science and technology planning agencies (which explains the fascination of so many Latin American scientists with Soviet style planning); or simply brushed away as two unrelated (but, in practice, strongly intertwined) practices and cultures[2].

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[2]This extraordinary ability of scientists to deny the reality of the strong links between "pure science" and its surrounding world is part of the "modernist" outlook so well described by Bruno Latour in *We Have Never Been Modern (*Harvard , 1993*)*.

The consequences of these policies can be summarized in a few points. A reasonably large number of graduate programs and research departments were organized in the country's public universities - two thousand graduate programs, 50 thousand graduate students, 15 thousand researchers. A few ambitious high technology projects were started, and a policy for technology self-sufficiency was attempted in the area of micro computing; cooperation technology projects were developed between the largest state-owned companies and some of the leading university departments. A fairly large constituency for fellowships and research grants was created, and a Ministry for Science and Technology was organized and given to scientists according to their demands. As resources dwindled and the world changed in the eighties and nineties, most high-technology, big science projects were kept on hold, the computer policy was abandoned, and most of the money available for research turned into salaries and fellowships. Two World Bank supported programs for science and technology development provided some breath to selected high technology areas. Spillovers from the science and technology sector to general education, industry and other sectors of government do not seem to have been very significant, except perhaps in the area of agribusiness. Academic production kept raising steadily, without, however, changing Brazil's position as a minor partner in the international science and technology effort.

While science policy moved slowly, rapid changes occurred both in the international and in the national environments. Internationally, the end of the cold war, the intensification of international competitiveness and globalization and the growing importance of knowledge-intensive products in the international market combined to bring the cozy affair between academic science and military technology to an end, and brought science, technology, higher education and the logic and needs of the market place much closer to each other than before. A new “paradigm”, or mode of knowledge production emerged, described by some authors as “mode II”, in contrast with the traditional, discipline-based, “mode I” of knowledge production. Mode II has been characterized by knowledge being produced in the context of application; transdisiplinarity; organizational diversity and heterogeneity; external accountability and reflexivity; and new mechanisms for quality control,

combining disciplinary and practical standards of evaluation[3]. Nationally, the opening of the economy to the international market brought new relevance and urgency to the firms ability to incorporate new technologies in their administrative and productive procedures, and in their abilities to innovate. At the same time, the need to balance the budgets, reduce public expenditures and give more relevance to the social agenda reduced the governments' generosity with the science and technology sector, both in terms of available resources and of legitimacy.

Given this context, what is the range of possible policies? One extreme is to insist on the traditional paradigm of autonomous science and ambitious technology projects, under the scientists' guidance. I would say that this view is still prevalent among scientists and in public universities, and permeates the administration of the main science and technology agencies. The fact that this a well perceived *cul de sac* does not seem to be enough to bring fresh alternatives and to induce new behavior.

The other extreme is to declare the death of "mode I", and switch all resources and actions to the support of "mode II" activities. This would mean to stop supporting basic science, and to stimulate all kinds of associations and links between science, technology and the market place. An open question, in this perspective, is whether there will still be a place of science policy, given the existing budget limitations, the generalized skepticism about the role of the state, and the opposite beliefs in the implicit rationality of the market place.

The 1992-3 science policy study suggested an intermediate path. Basic science and graduate academic higher education should continue to get support according to traditional "mode I" procedures, within strict criteria of quality. Large, expensive technological and big science projects should be subject to cost-effectiveness evaluations. Instead of populist distribution of research money, scientific elitism; instead of elitist, high technology projects; intensive dissemination of new technological instruments and skills. The notion that the country was technologically "encircled" had to be replaced by

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[3]M. Gibbons, C. Limoges, H. Nowotny, S Schwartzman, P. Scott and M. Trow, *The New Production of Knowledge - the dynamics of science and research in contemporary societies*, Sage, 1994.

open linkages with the international markets for knowledge and technology. A growing percentage of public resources for science and technology should be explicitly linked with applications, and a sustained effort should be made to improve the innovative capabilities of the productive sector and the general quality of education at all levels.

There is always a big gap between policies in paper and in real life. The general consensus in Brazil today seems to be that this is the proper direction to go, but movement has been slow, and one may wonder whether there are better paths to follow, or other ways of moving more quickly along this road.

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